

California heat waves: the July 2006 event in historical and future context

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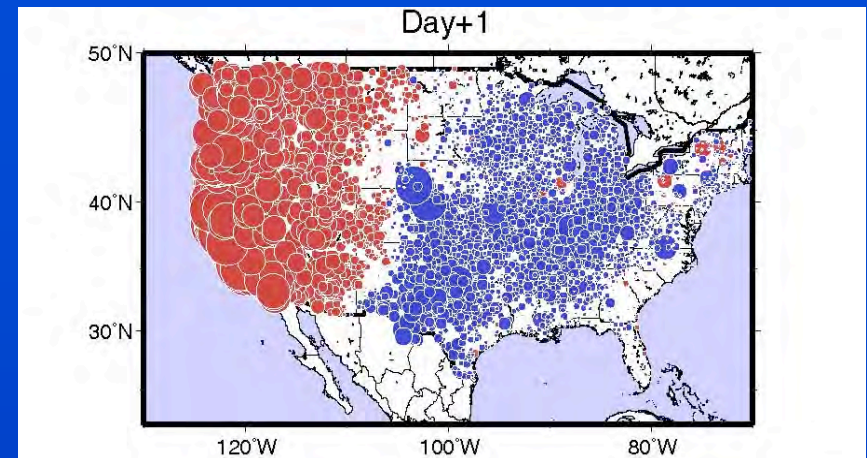
Thanks: Laura Edwards, Emelia Bainto, Mary Tyree

California Energy Commission PIER program
NOAA Office of Global Programs, DOE
<http://meteora.ucsd.edu/CAP/>

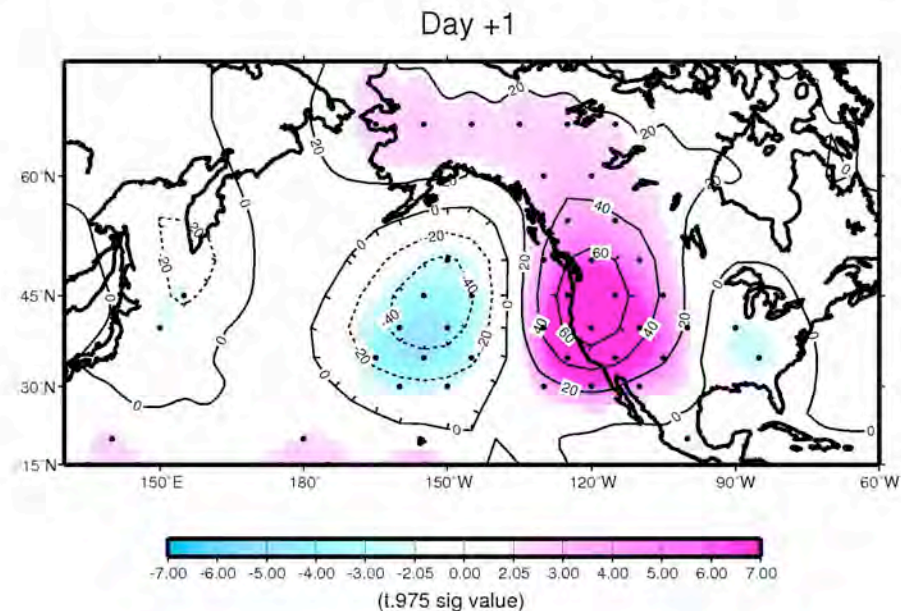


Longer heat waves tend to have broad footprints

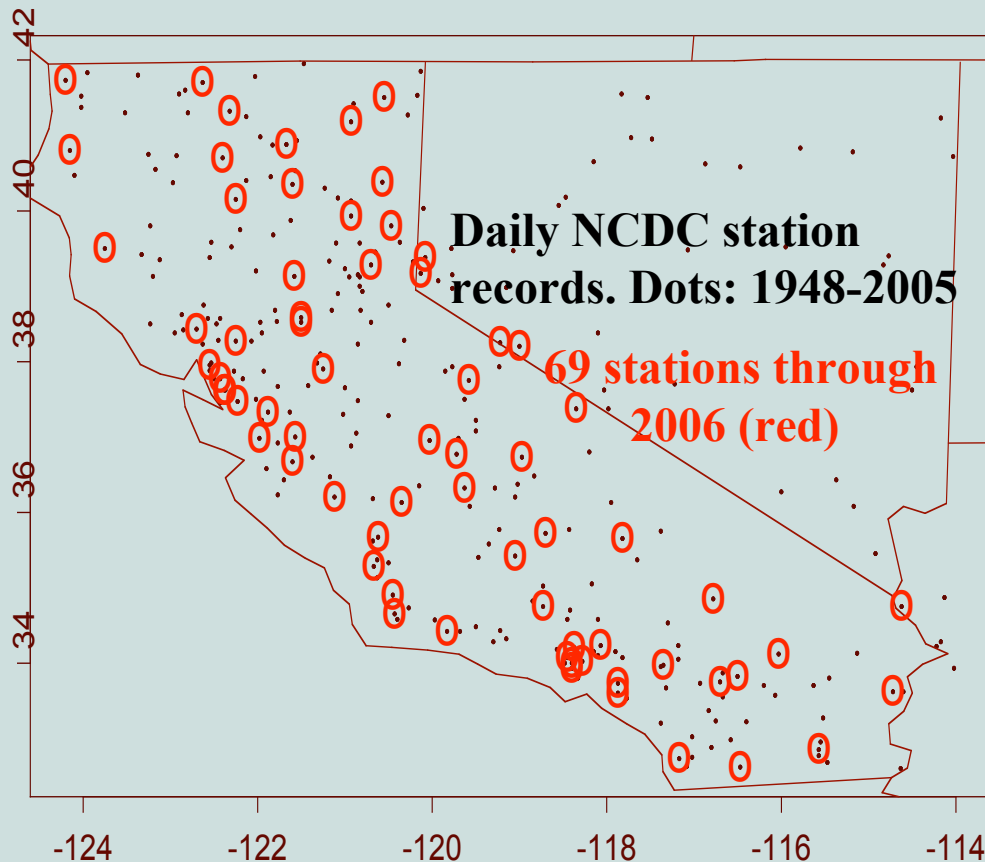
Composite Tmax and 700mb height Anomalies from 31 historical 3d and longer heat wave events (1948-2005)



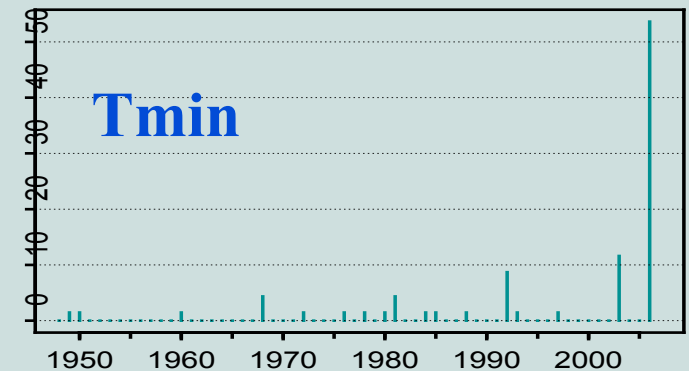
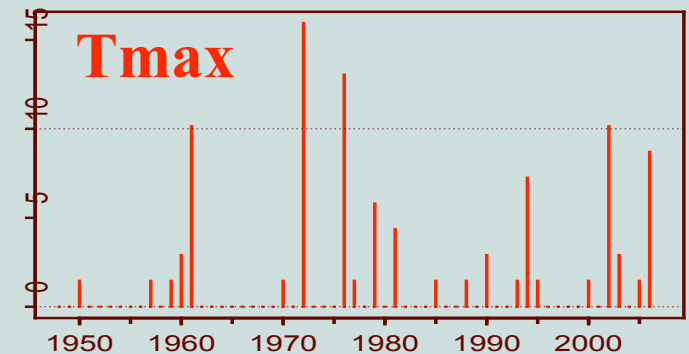
Composite 700ht Anoms, 31 Hi Tmax dates lasting ≥ 3 days
(days when ≥ 9 Sasha stns have hot days by 99%ile criteria)



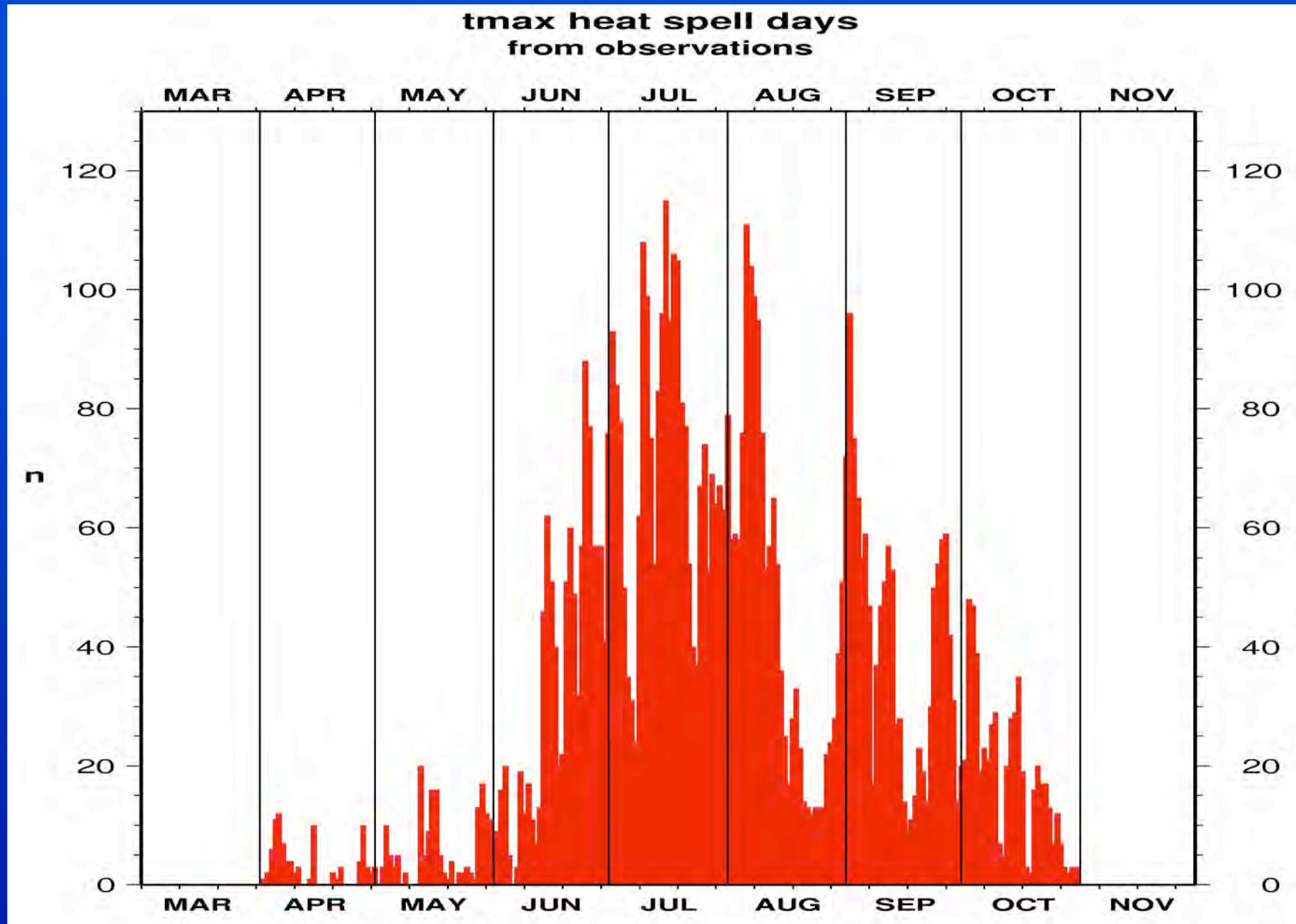
California Heat Waves: 2006 vs. historical record



» Locally extreme temperature exceeding a high percentile threshold t^* (e.g. 99%-ile)

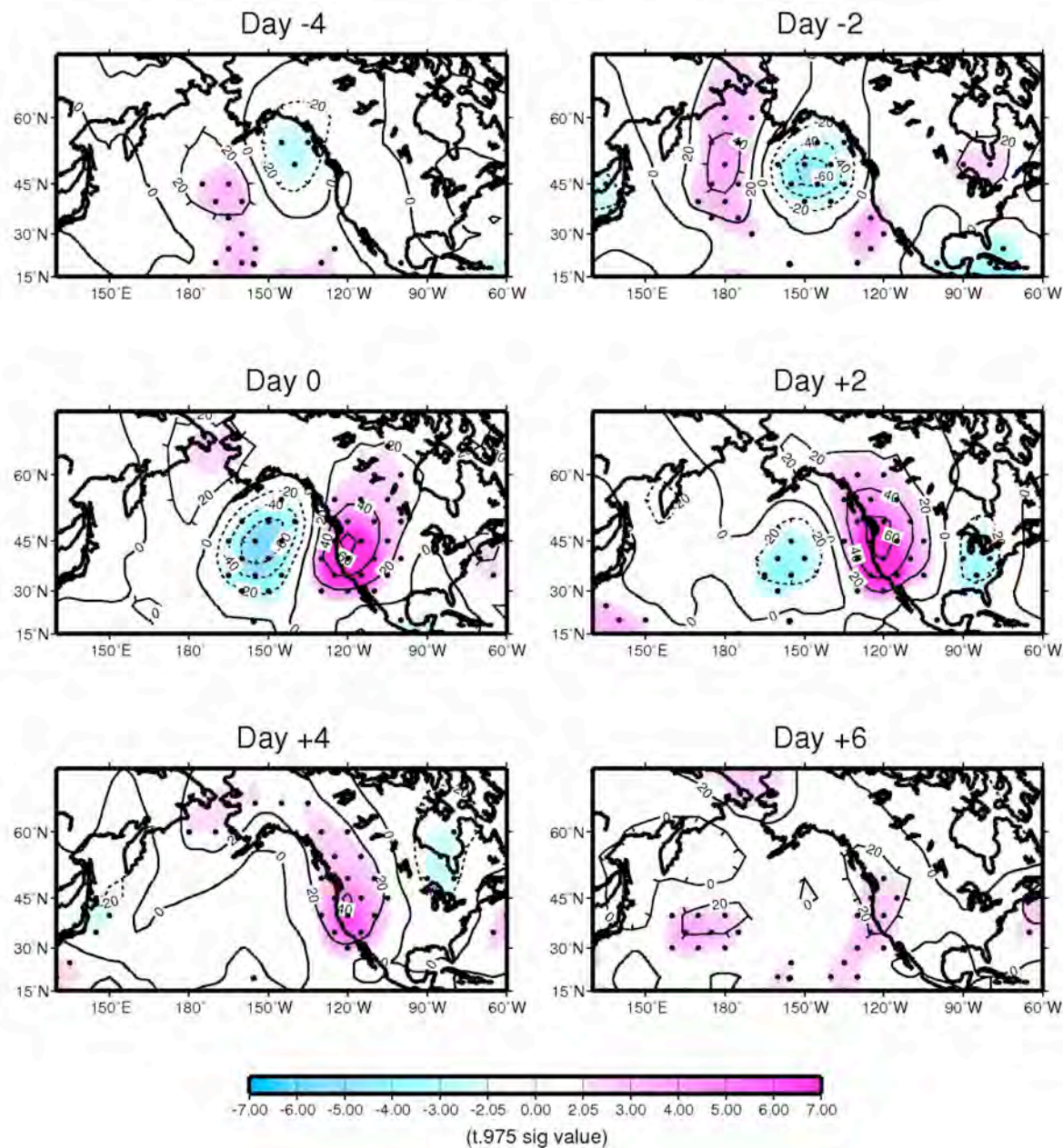


CA heat wave index:
%-age of stations under extreme heat during **day** and **night**



Concentration of heat wave events in June-September

Composite 700ht Anoms, 31 Hi Tmax dates lasting ≥ 3 days
(days when ≥ 9 Sasha stns have hot days by 99%ile criteria)

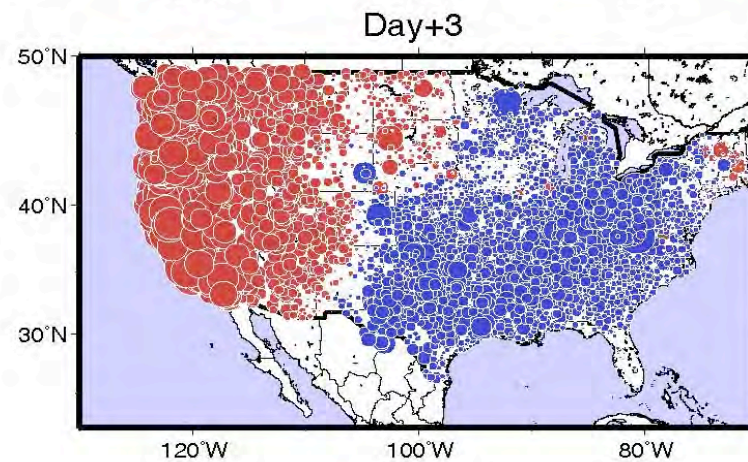
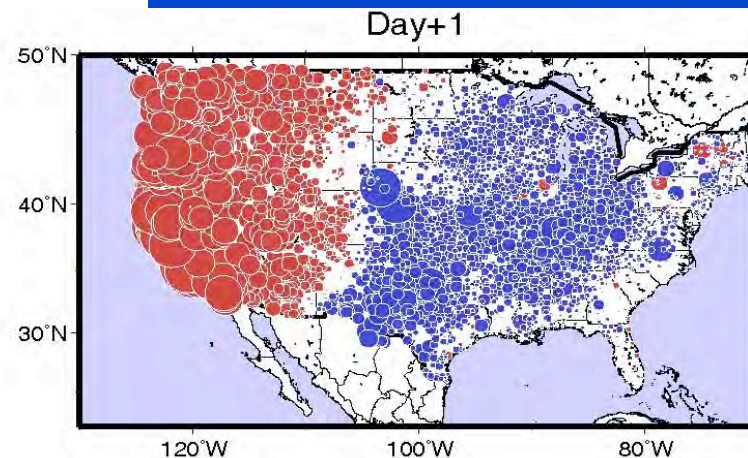
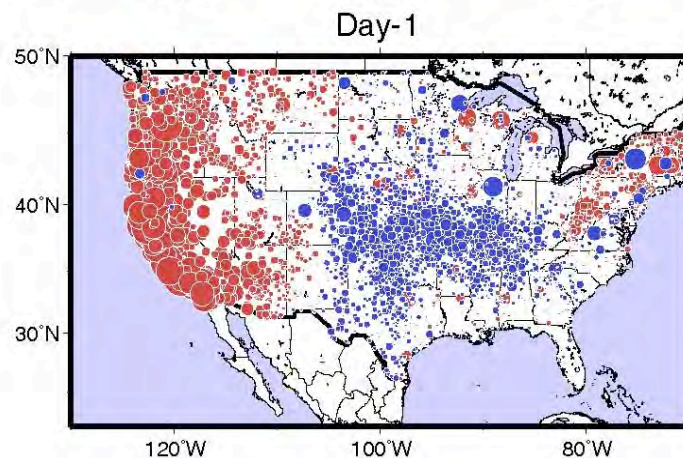
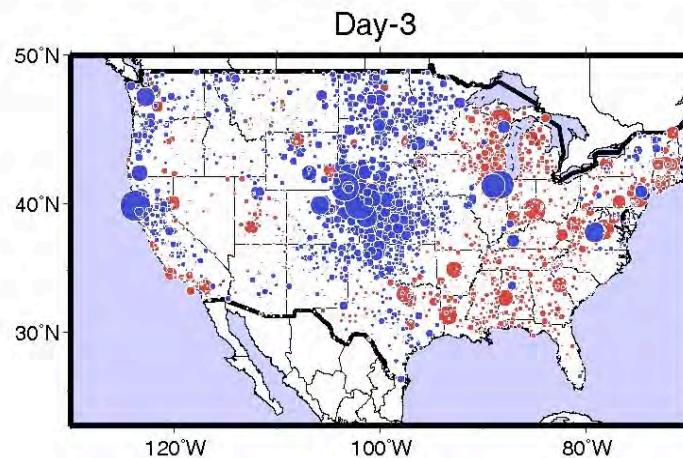


**Circulation
during
A heat wave
episode**

**700 mb height
anomalies
composited
4 days before
through
6 days after
start date**

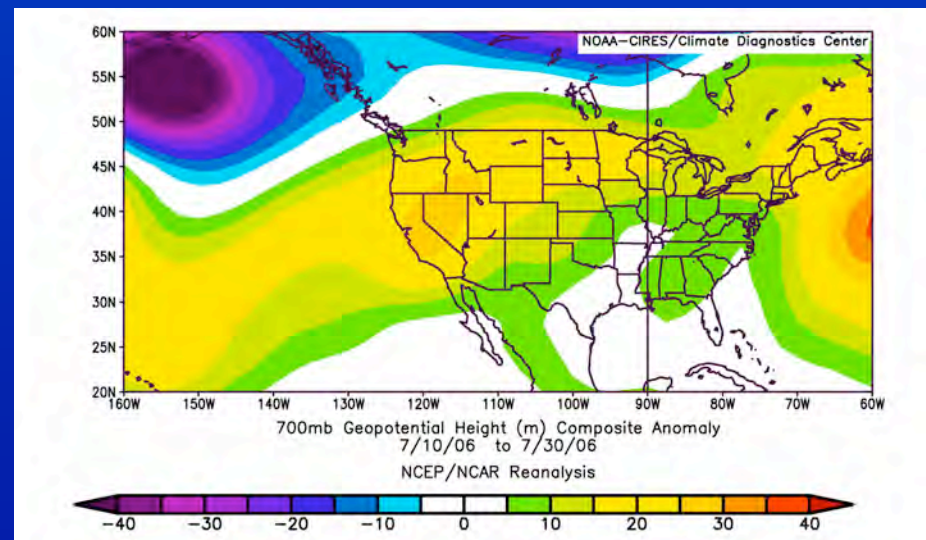
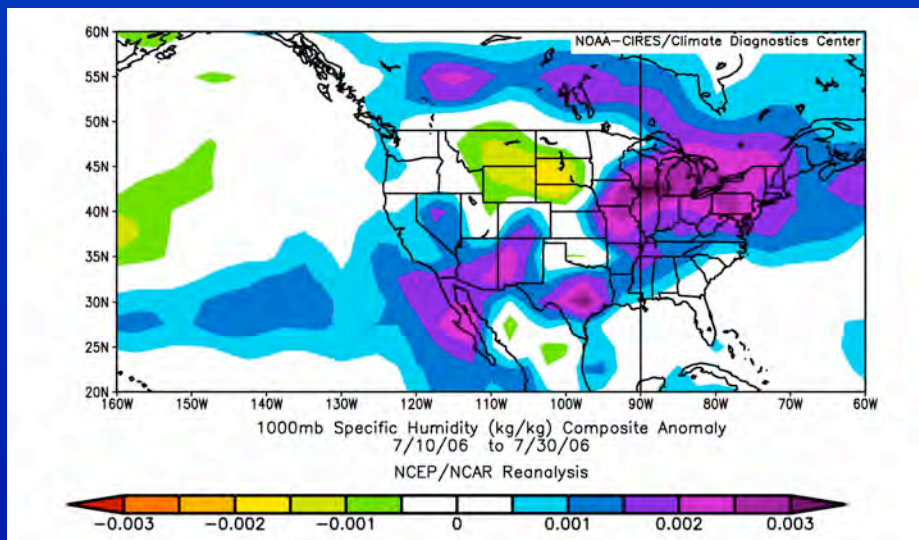
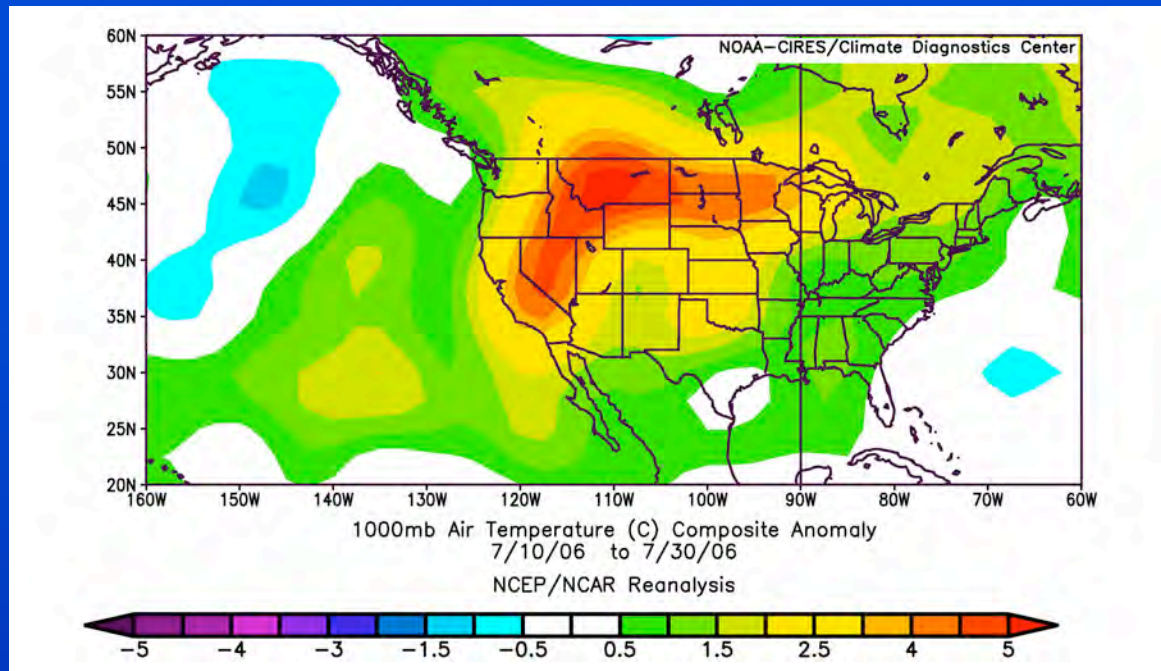
Comp Dly Stn Tmax DM, 31 Hi Tmax dates lasting ≥ 3 days

West-wide expression:
Tmax anomalies
3d before through 3d after

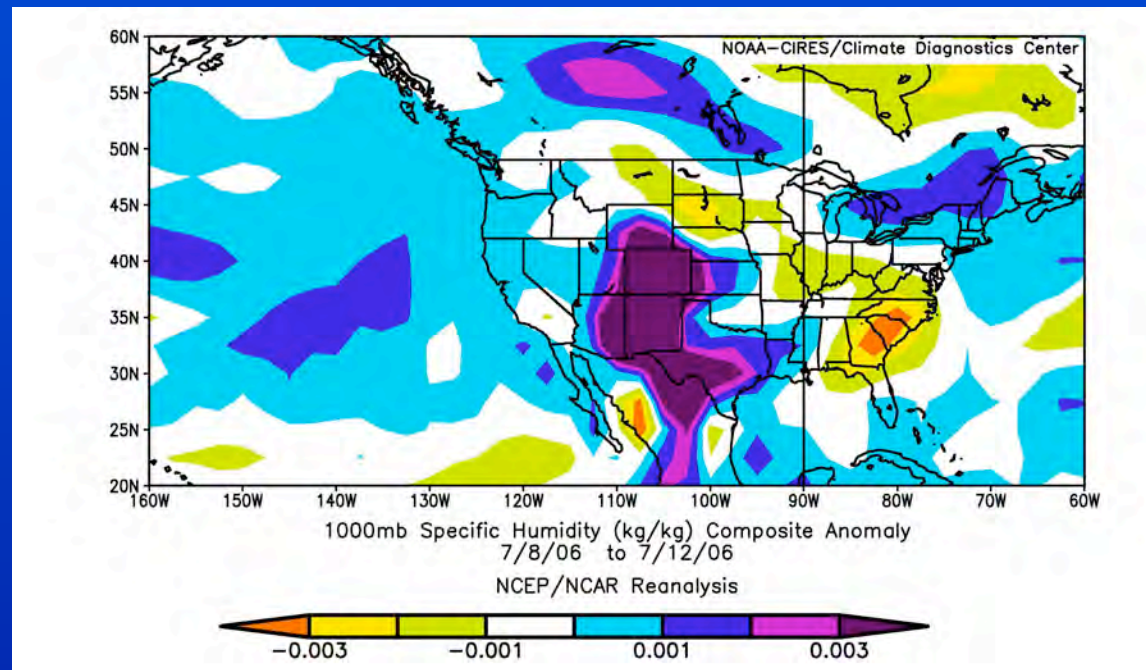


● Tmax DM = $+5^{\circ}\text{C}$

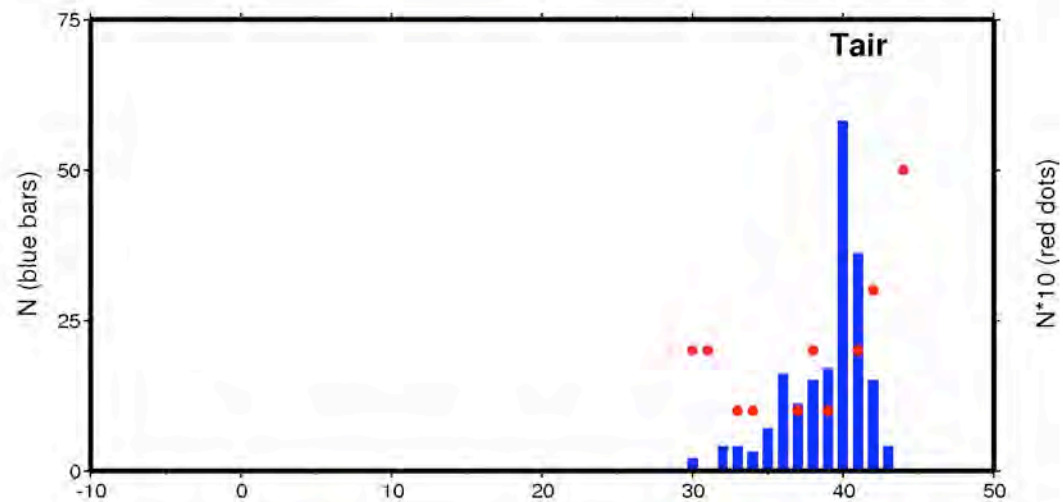
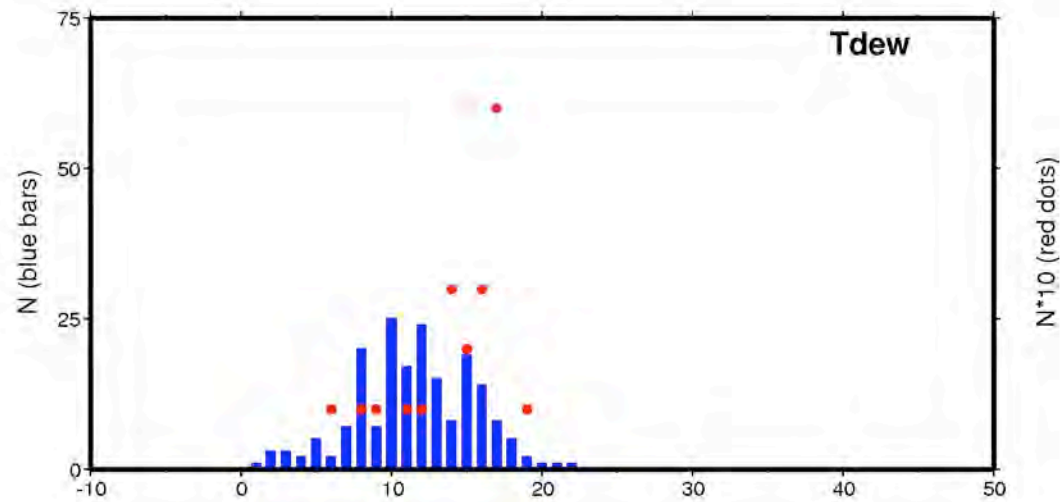
July 2006 Temperature Humidity Circulation anomalies



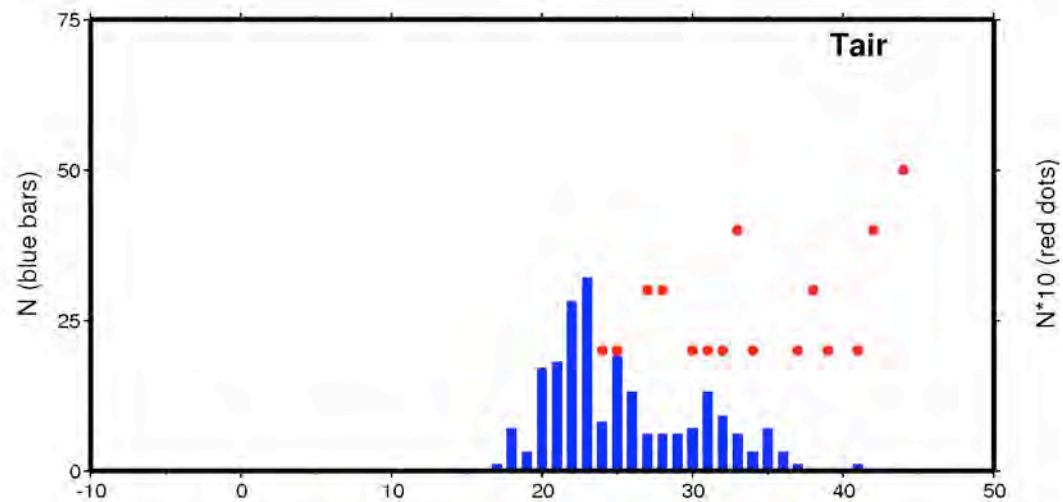
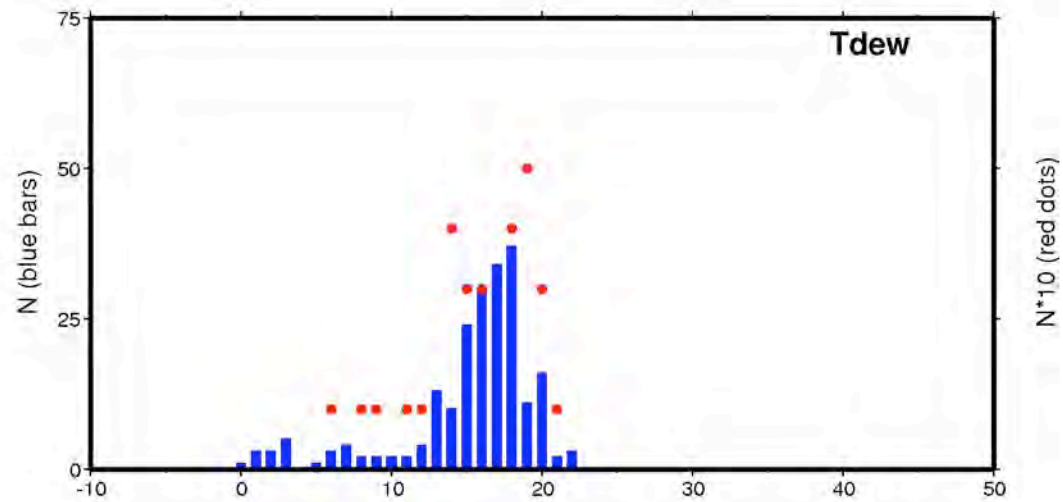
Near-surface humidity anomalies during July 2006



Fresno, CA (KFAT) No. of Tdew/Tair obs (3PM PST)



San Diego, CA (KSAN) No. of Tdew/Tair obs (3PM PST)

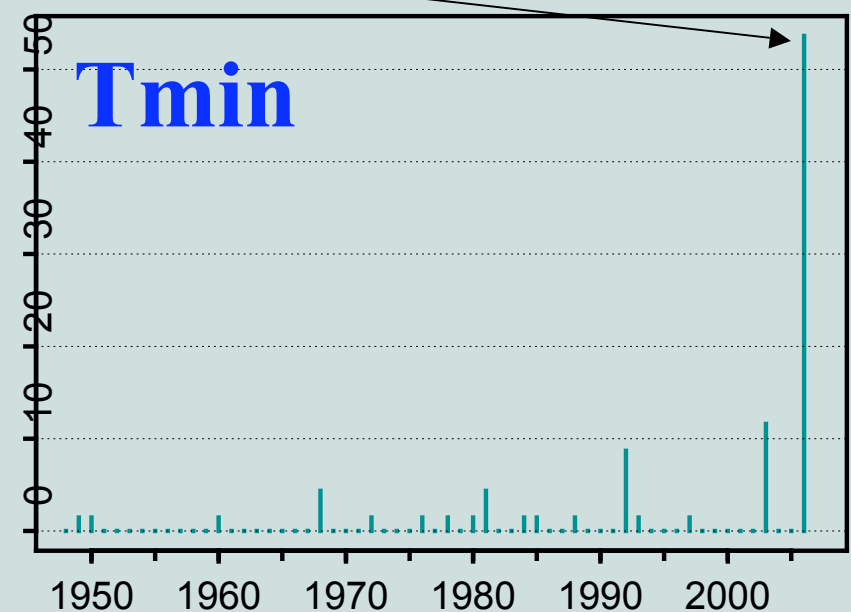
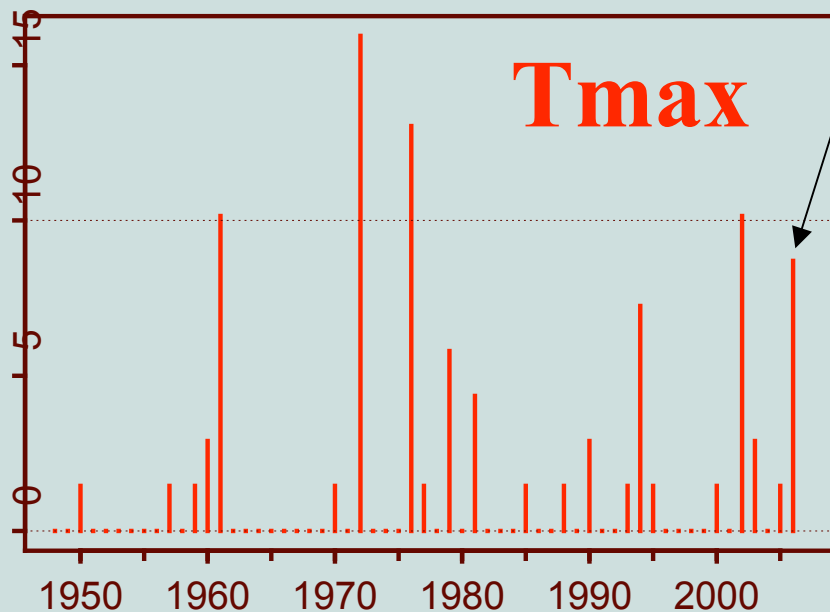


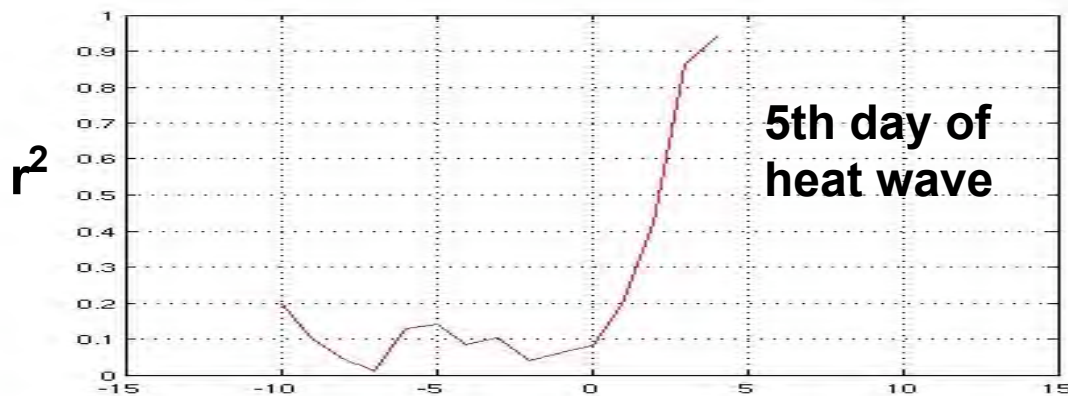
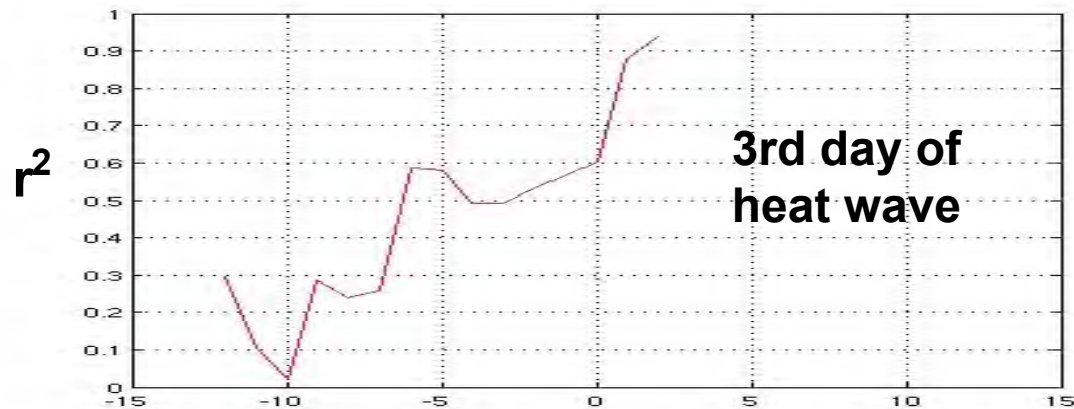
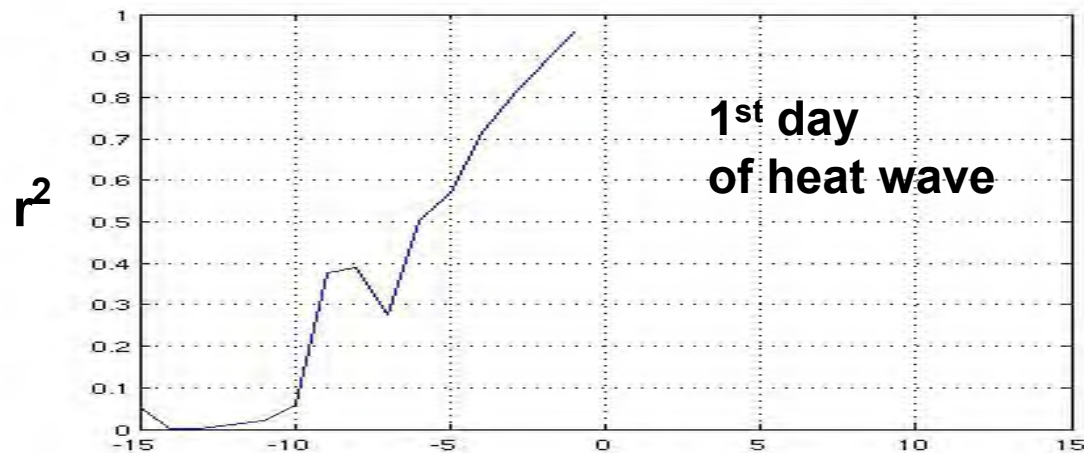
Daytime and Nighttime Statewide Heatwave Activity

Daytime Maximum Temperature events: episodic, not prominent every year

Nighttime Minimum Temperature events: have increased over last 50 years,
2006 had remarkably warm Tmin

2006



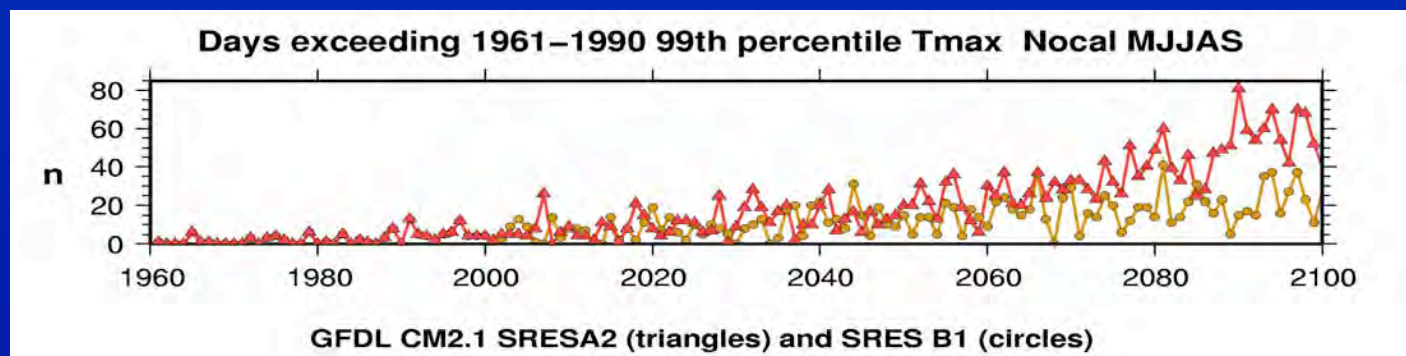
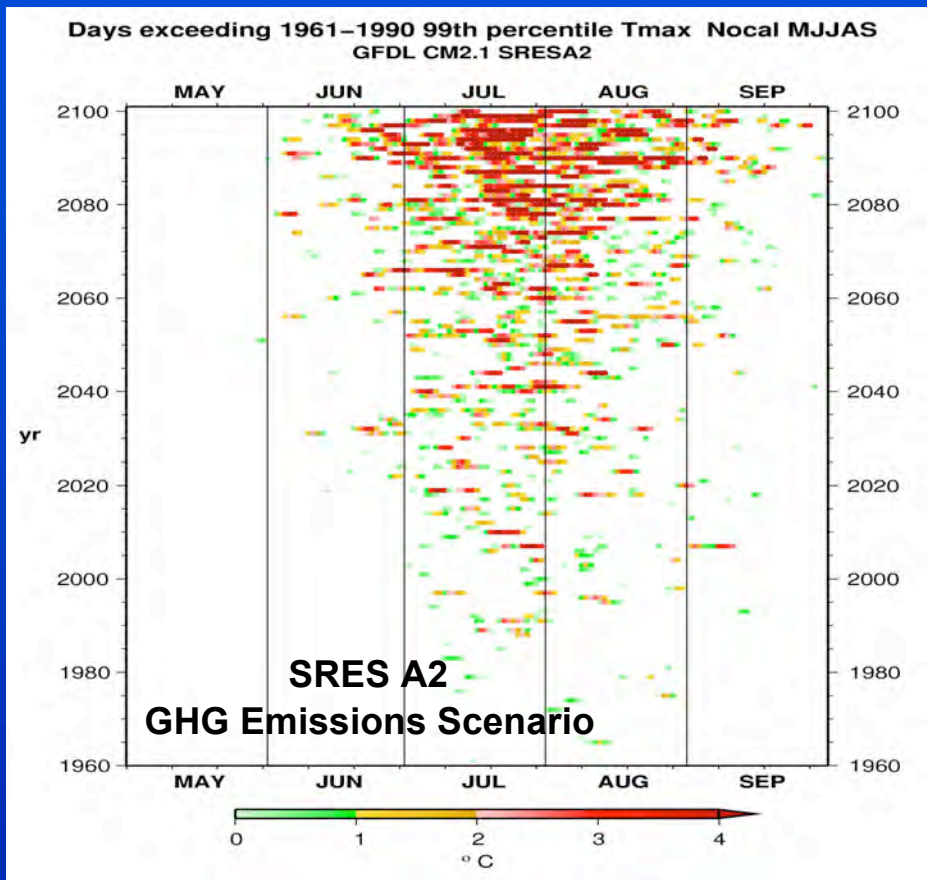
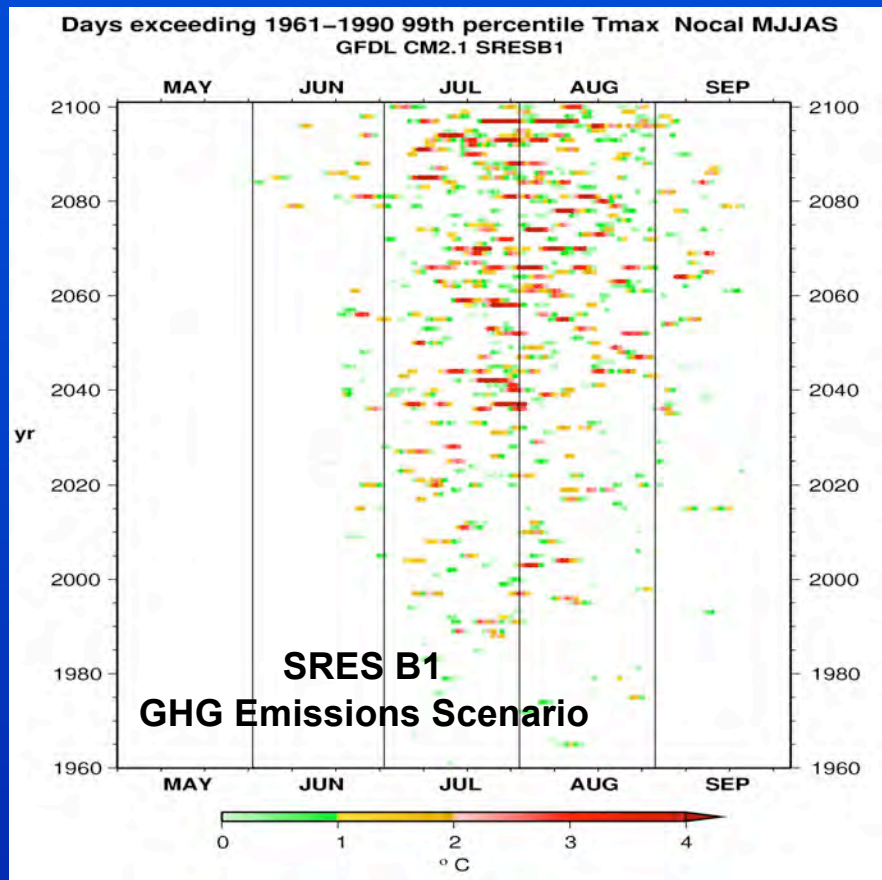


Days lead

**Medium
range
forecast
skill
15d-1d in
advance**

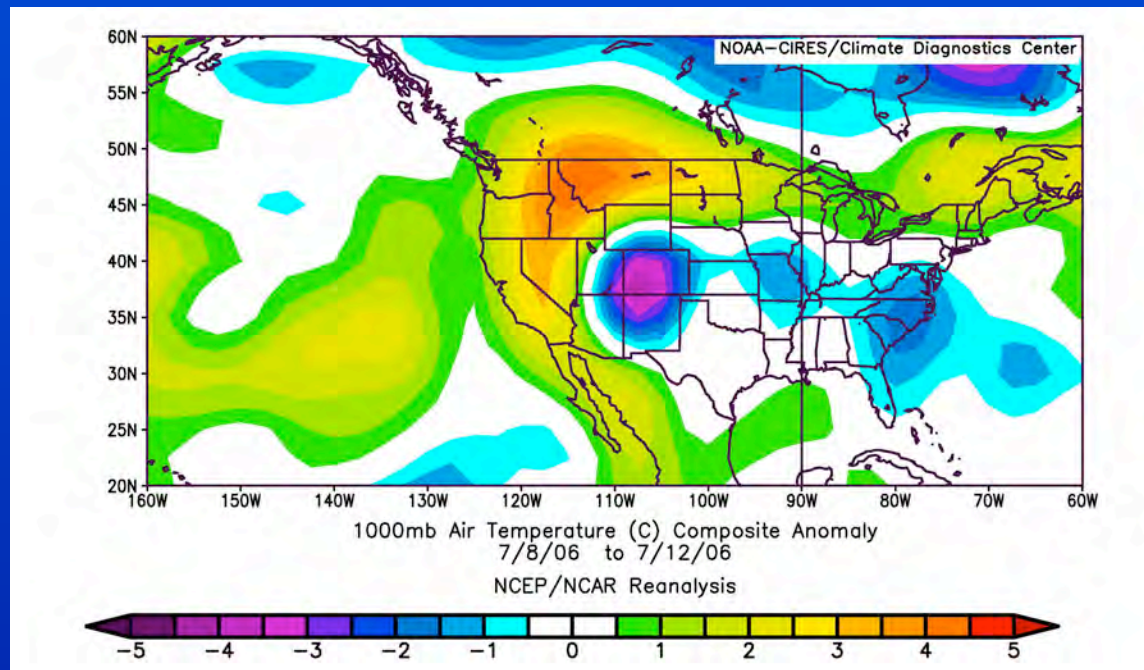
**Los
Angeles
area,
Heat spell
(3days and
longer)
days**

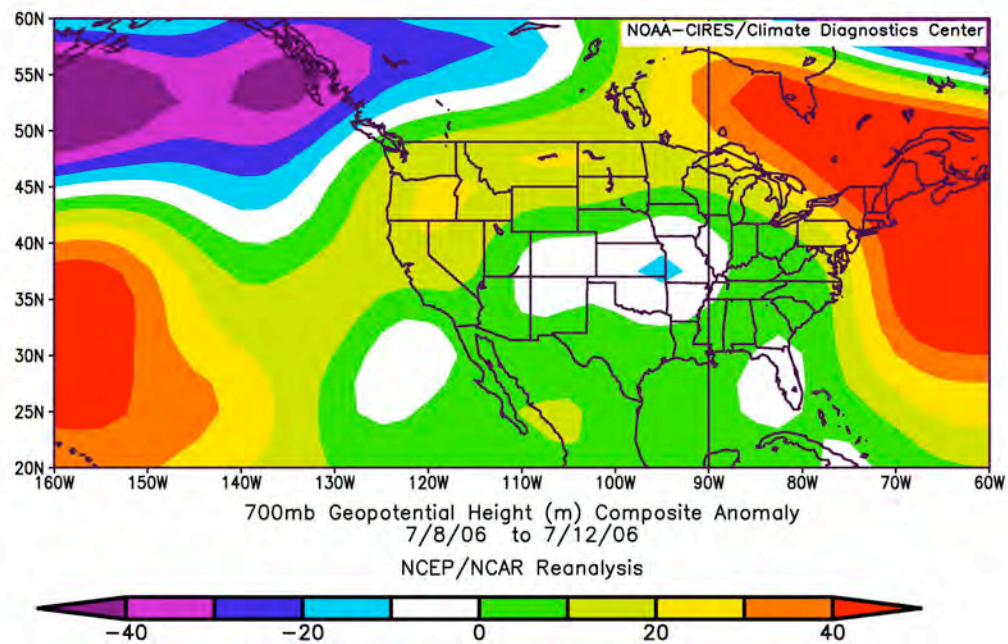
Climate Change Projections Heat wave days











Working definition of *extreme heat*

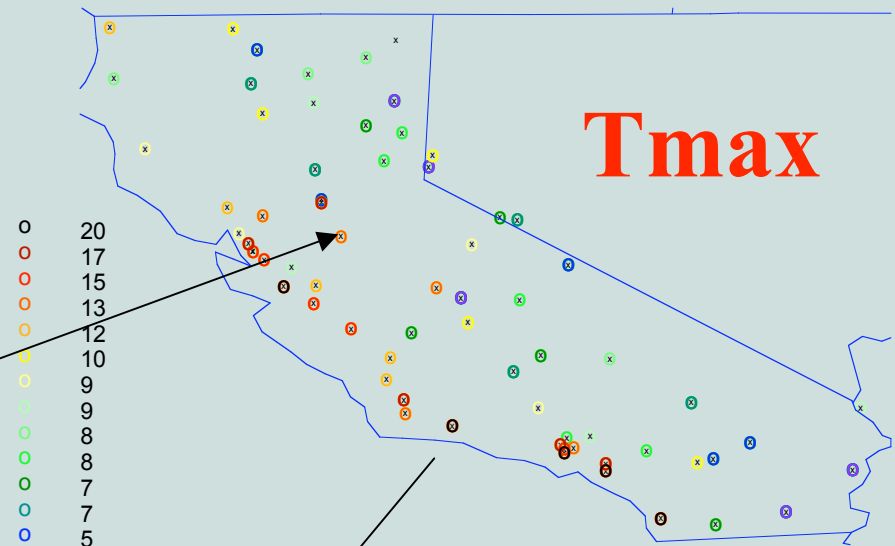
- Locally extreme temperature exceeding a high percentile threshold t^* (e.g. 99%-ile)
- Local heat wave magnitude and duration reflected in summing exceedance over threshold: $\sum(t_i - t^*)$, for all days (i) in a season such that $(t_i > t^*)$ in a season
- Spatial extent of locally extreme conditions

**Seasonal view of
daily extremes in
time and space:
*individual
seasons vs. multi-
year climatology***

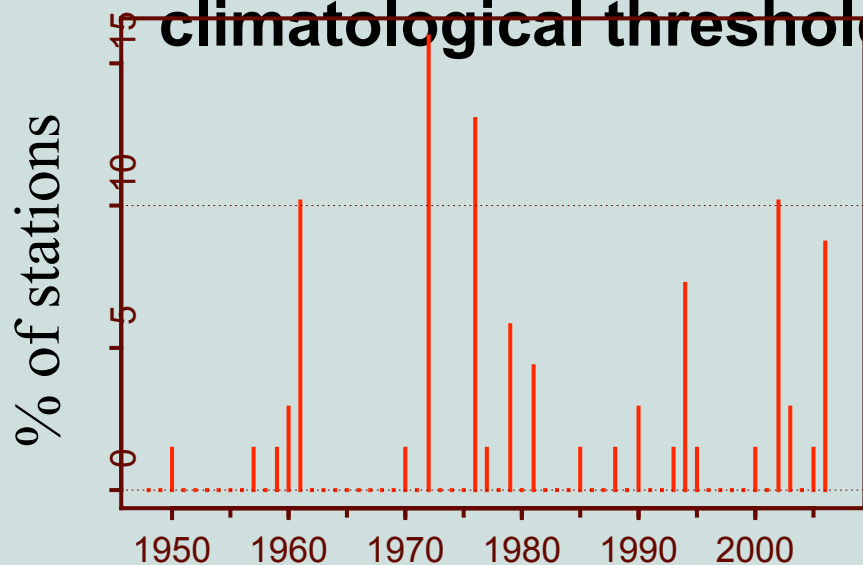
Working definition of *extreme heat*?

- Spatial extent (weighted by population) of locally extreme conditions is computed for each year as percentage of stations at which exceedance sums are above the climatological threshold

99th %-ile of climatological exceedance sums



This gives the percentage of stations where heatwave activity was extreme

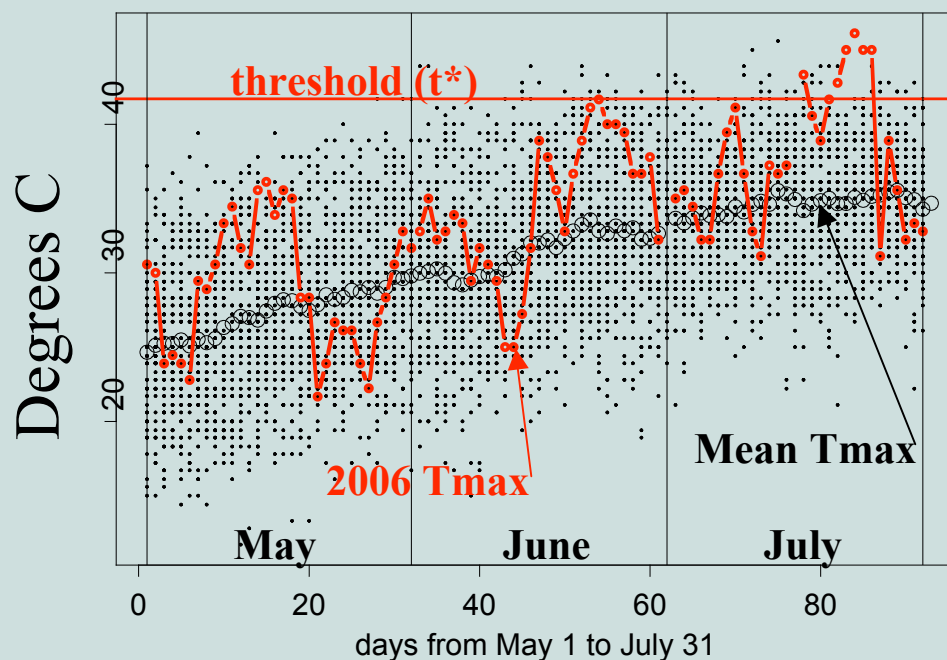


Working definition of *extreme heat*

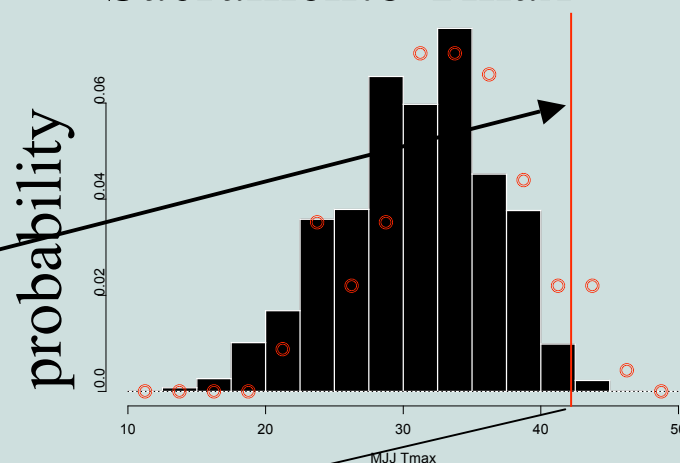
Tmax

- Locally extreme temperature exceeding a high percentile threshold t^* (e.g. 99%-ile)

Time series view



Sacramento Tmax

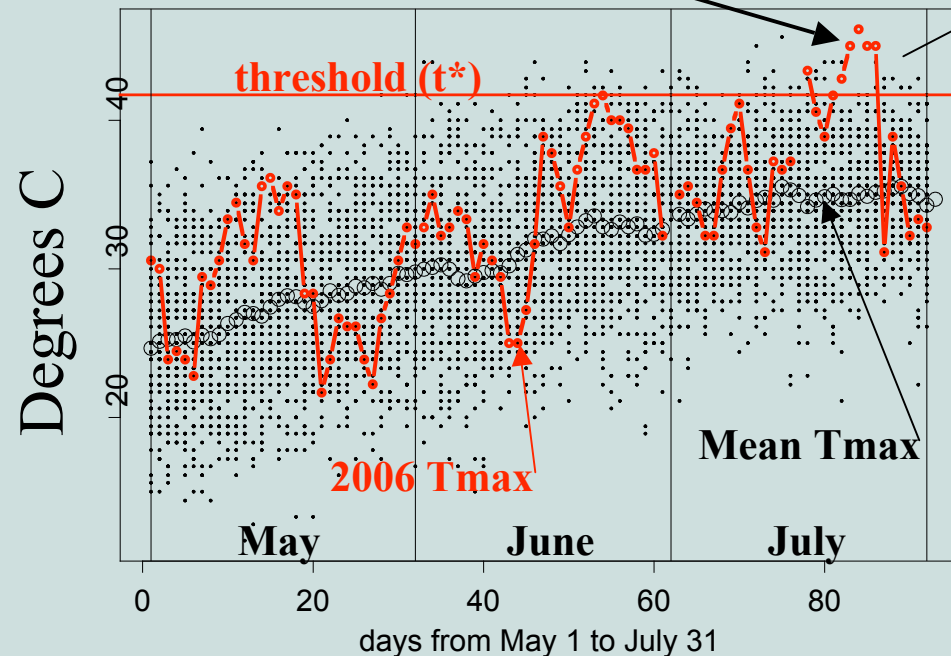


Bars: 1948-2005 Tmax histogram,
Circles: 2006 Tmax histogram, and
Vertical line: all-yr 99th %-ile

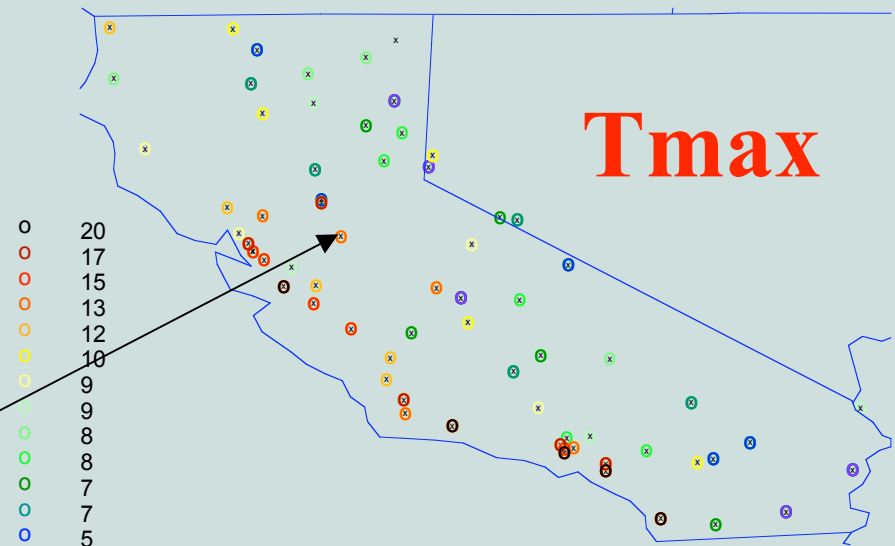
**Each season is compared
to local climatology**

Working definition of *extreme heat*

- Local heat wave magnitude and duration reflected in summing exceedances over threshold: $\sum(t_i - t^*)$, for all days (i) in a season such that $(t_i > t^*)$



99th %-ile of climatological exceedance sums



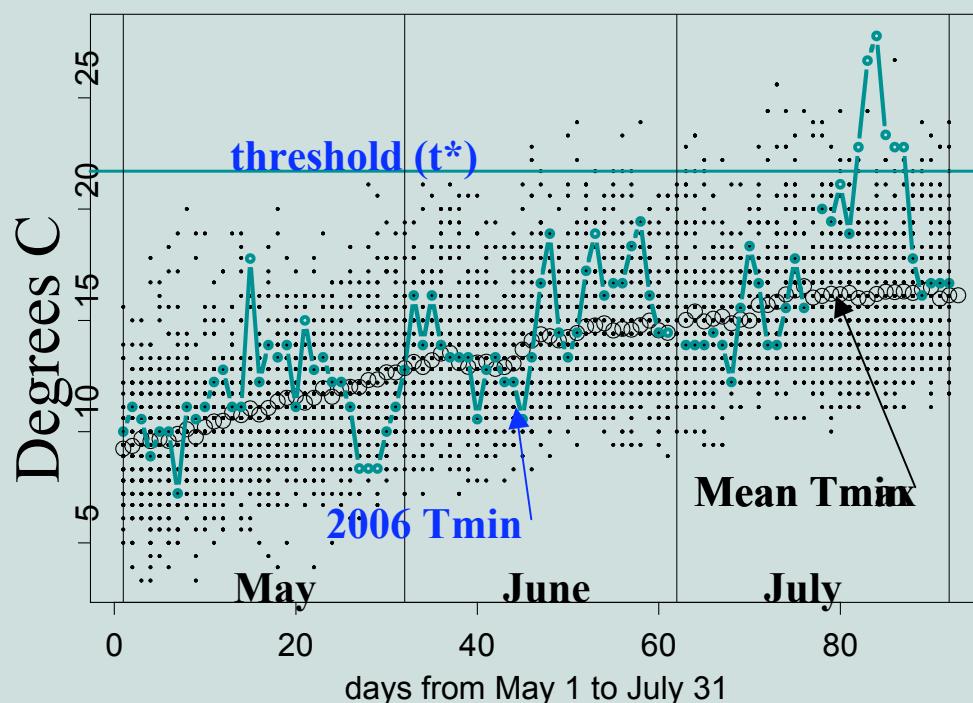
Exceedance sums are computed for each year at each station on our network that is weighted towards most populated areas

Working definition of *extreme heat*

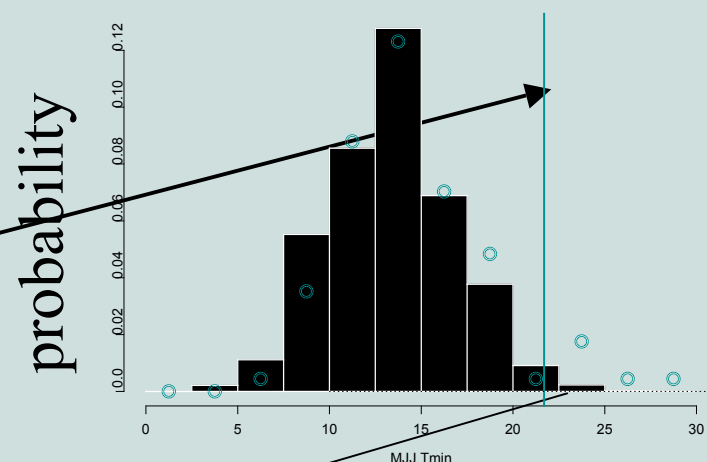
Tmin

» Locally extreme temperature exceeding a high percentile threshold t^* (e.g. 99%-ile)

Time series view



Sacramento Tmax

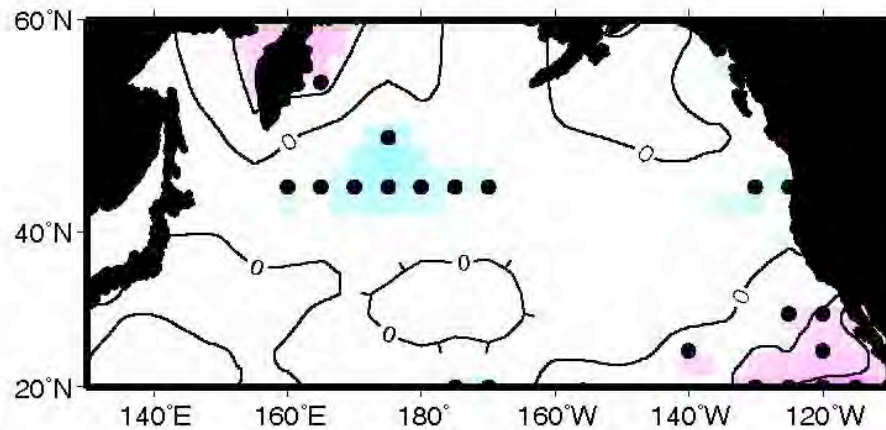


Bars: 1948-2005 Tmax histogram,
Circles: 2006 Tmin histogram, and
Vertical line: all-yr 99th %-ile

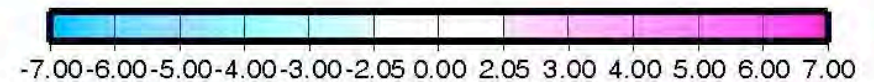
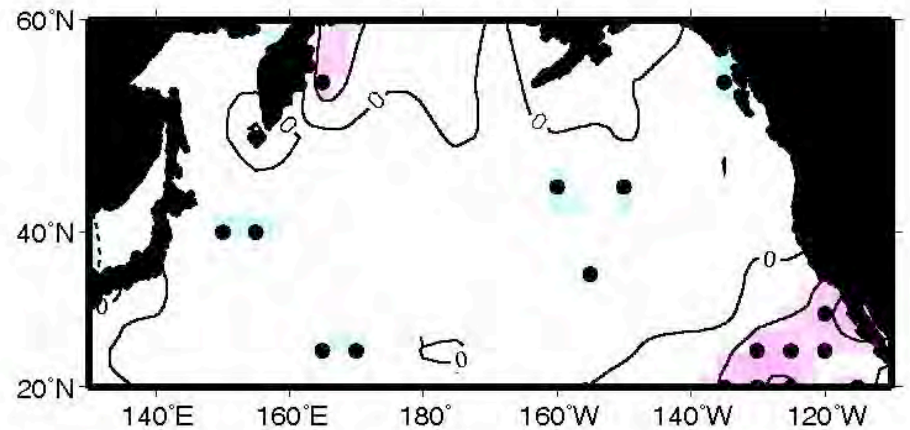
**Each season is compared
to local climatology**

Composite SST Anoms (deg F), Hi Tmax Dates ≥ 3 days

Month-1

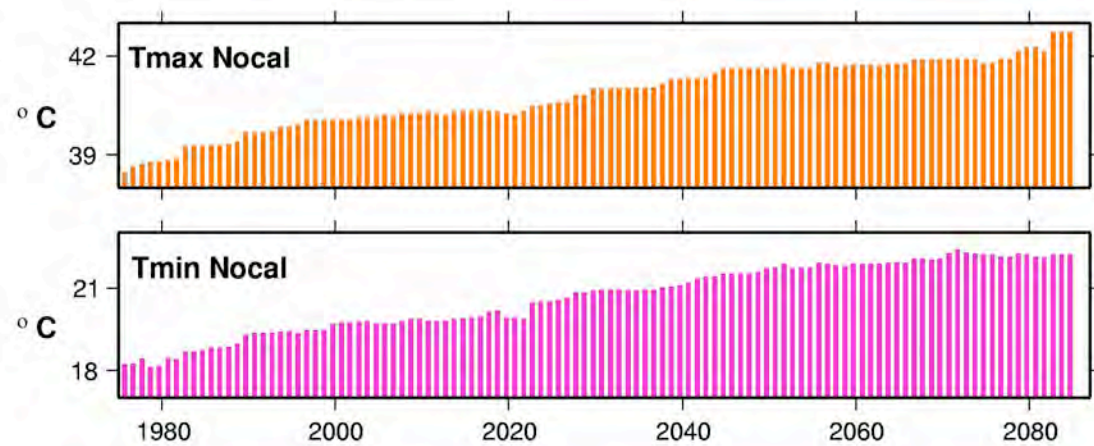


Month 0



(t.975 sig val)

Projected 99th percentile Temperatures MJJAS



from sliding 30-yr periods centered at years 1976 to 2085
GFDL CM2.1 SRES B1